

Indian Ocean echinoderms collected during the *Sindbad Voyage* (1980–81): 1. Holothurioidea

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Introduction

As a result of studies initiated during the last century (Semper, 1868; Ludwig, 1875, 1882, 1891; Bell, 1884–89; Théel, 1886; Pearson, 1913, 1914), and which have continued to the present time (e.g. Daniel & Halder, 1974; Sloan *et al.*, 1979; Aziz, 1981), knowledge of the systematics and distribution of Indian Ocean holothurians is appreciable. Many of the works are cited in the bibliographies of Domantay (1957), Clark & Rowe (1971), Jones (1971), Daniel & Halder (1974) and Rowe & Doty (1977). However, in spite of these surveys, information on holothurians in some parts of the Indian Ocean is still rather limited. These areas include certain remote island groups such as the Laccadives (Lakshadweep), as well as much of the area comprising Indonesia and Malaysia. With regard to the Laccadives, there is occasional mention of holothurians in the literature (e.g. Koehler & Vaney, 1908; Hornell, 1917; James, 1976), whereas apart from the 'Valdivia' Expedition (Heding, 1940) Sumatra appears not to have been included in any of the studies on Indonesian holothurians (e.g. Roberts, 1979; Roberts & Darsono, 1984; Aziz, 1981).

This paper represents an attempt to fill in some of the gaps in knowledge. Collections of holothurians (and other echinoderms) were made at the Laccadives, Sumatra and other localities during a voyage across the Indian Ocean from Oman to China. The expedition, *Sindbad Voyage*, was undertaken in 1980–81 using a replica of an ancient Arab sailing vessel, *Sohar*. For each of the 32 holothurian species collected, brief systematic notes are given, along with basic locality and habitat/depth information. Accounts of the other echinoderm classes/subclasses, and a detailed ecological study carried out in Sumatra, are to be published subsequently.

Methods

Specimens were collected by one of us (A.R.G.P.) and other expedition members at localities around Muscat, Oman; Chetlat Is., Laccadives; Beypore, India; Pula Wé Is., Sumatra. Details of the sampling areas are shown in Fig. 1. Sampling was undertaken principally on coral reefs using scuba. At each locality, details of habitat type and water depth, or depth range if exact depth was not noted, were recorded, along with the number of individuals of each holothurian species.

Material was relaxed, fixed and preserved using standard methods (Lincoln & Sheals, 1979). Some preliminary identifications were made by A.R.G.P. in the field and aboard *Sohar*, but the majority of specimens were identified by C.E.R. and checked by Miss A. M. Clark at the British Museum (Natural History), where the collections have been deposited.

Systematic account

Throughout this account, references are often given just to major works such as Clark & Rowe (1971) and Rowe & Doty (1977) from which the original specific descriptions can be traced.

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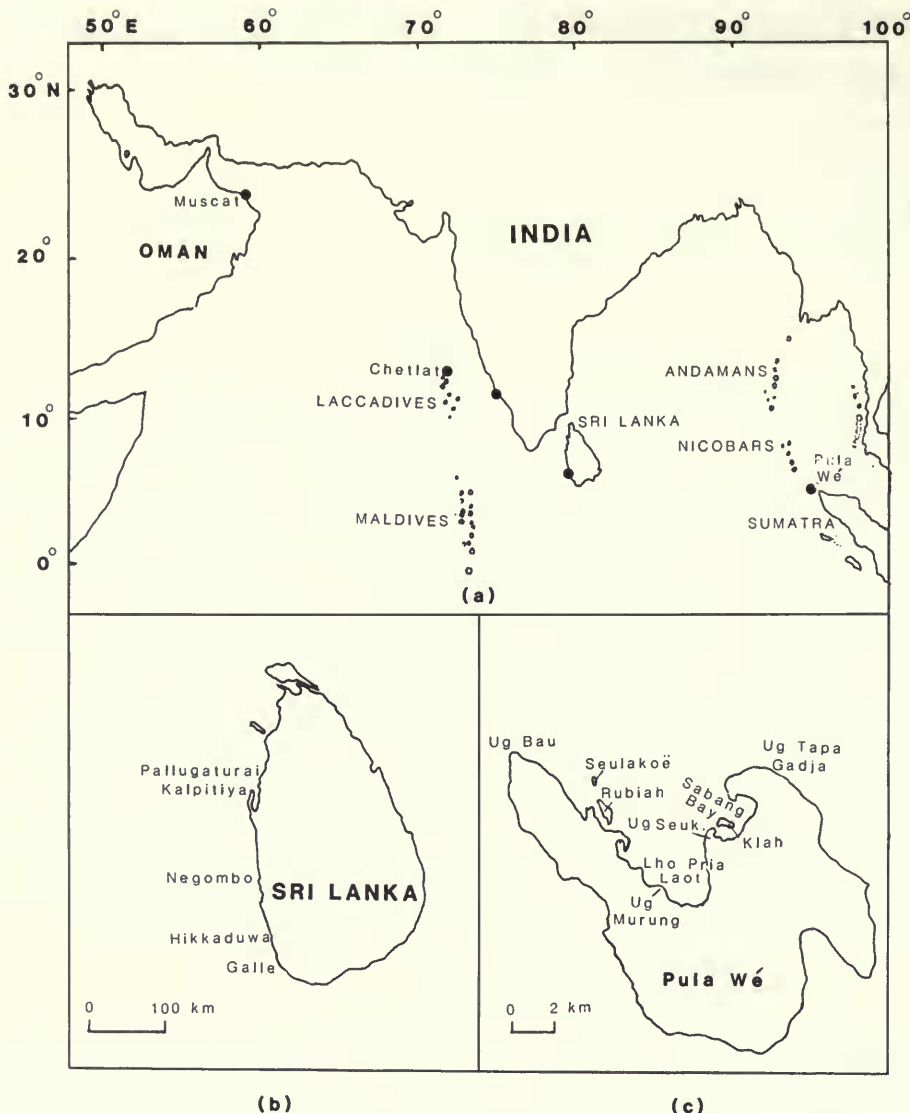


Fig. 1 (a) Map of northern Indian Ocean showing sampling areas (●) during *Sindbad Voyage*, with insets for two areas sampled at several localities; (b) Sri Lanka; (c) Pula Wé, Sumatra.

References dealing with the biology of a species are sometimes also included, if the additional information is considered to be useful. This follows the practice of Sloan *et al.* (1979), and obviates the need for providing detailed synonymies.

Class HOLOTHURIOIDEA HOLOTHURIIDAE

1. *Actinopyga echinites* (Jaeger, 1833)

SEE: Cherbonnier, 1955 : 136; Rowe & Doty, 1977 : 288.

COLLECTION SITE: Galle, Sri Lanka (1 specimen).

HABITAT & DEPTH: Sublittoral bedrock; 5–10 m.

2. *Actinopyga lecanora* (Jaeger, 1833)

SEE: Koehler & Vaney, 1908 : 21 (as *Mülleria lecanora*); Clark & Rowe, 1971 : pl. 27, fig. 2.

COLLECTION SITES: Seulakoë, Ug Murung, SW Rubiah Is. and Ug Seukundo, Pula Wé, Sumatra (4 specimens & at least 5 observed but not collected).

HABITAT & DEPTH: Sublittoral rock, coral/sublittoral rock, coral reef sand; 2–20 m.

3. *Actinopyga mauritiana* (Quoy & Gaimard, 1833)

SEE: Rowe and Doty, 1977 : 228.

COLLECTION SITES: Chetlat Is., Laccadives: Hikkaduwa, Sri Lanka (2 specimens).

HABITAT & DEPTH: Coral reef, coral rubble; 2 m & 6 m.

4. *Actinopyga miliaris* (Quoy & Gaimard, 1833)

SEE: Panning, 1944 : 47 (as *A. lecanora miliaris*).

COLLECTION SITE: Klah, Pula Wé, Sumatra (1 specimen).

HABITAT & DEPTH: Coral reef sand; 4–5 m.

Actinopyga sp.

Individuals with details of spicules insufficiently distinctive for specific determination.

COLLECTION SITES: Muscat, Oman; Klah and Ug Bau, Pula Wé, Sumatra (3 specimens).

HABITAT & DEPTH: Coral reef sand; 2–20 m.

5. *Bohadschia graeffei* (Semper, 1868)

SEE: Rowe & Doty, 1977 : 229.

COLLECTION SITES: Chetlat Is., Laccadives; Ug Seukundo and Klah, Pula Wé, Sumatra (4 specimens).

HABITAT & DEPTH: Coral reef, coral reef sand; 4–20 m.

6. *Bohadschia marmorata* Jaeger, 1833

SEE: Rowe & Doty, 1977 : 229.

Collection sites: Chetlat Is., Laccadives; Ug Seukundo and Lho Pria Laot, Pula Wé, Sumatra (3 specimens).

HABITAT & DEPTH: Coral reef sand, sublittoral sand; 1–20 m.

7. *Labidodemas* sp.

Individuals with spicules insufficiently distinctive for specific determination.

COLLECTION SITE: SE Klah, Pula Wé, Sumatra (1 specimen).

HABITAT & DEPTH: Sublittoral rock; 2 m.

8. *Holothuria (Acanthotrapeza) coluber* Semper, 1868

SEE: Semper, 1868 : 90.

COLLECTION SITE: S Klah, Pula Wé, Sumatra (1 specimen).

HABITAT & DEPTH: ? Coral reef; 12–15 m.

9. *Holothuria (Acanthotrapeza) pyxis* Selenka, 1867

SEE: Rowe, 1969 : 138.

COLLECTION SITE: SE Klah, Pula Wé, Sumatra (1 specimen).

HABITAT & DEPTH: Sublittoral rock/coral; 2 m.

10. *Holothuria (Cystipus) rigida* (Selenka, 1867)

SEE: Rowe & Doty, 1977 : 234.

COLLECTION SITE: SE Klah, Pula Wé, Sumatra (1 specimen).

HABITAT & DEPTH: Sublittoral rock/coral; 2 m.

11. *Holothuria (Halodeima) atra* Jaeger, 1833

SEE: Rowe & Doty, 1977 : 230; Bonham & Held, 1963 : 305 (ecology); Bakus, 1968 : 24 (ecology).

COLLECTION SITES: Muscat, Oman; Chetlat Is., Laccadives; Pallugaturai, Galle and SW Kalpitiya, Sri Lanka; N, S & SW Klah, SE Lho Pria Laot, E Sabang Bay and ?Ug Seukundo, Pula Wé, Sumatra (17 specimens). Individuals were also observed, but not collected, at several localities including Chetlat Is., where large numbers were present in a lagoon.

HABITAT & DEPTH: Intertidal mud/sand, mixed rock/coral and sand beach, sublittoral rock, coral rubble, coral conglomerate, coral sand; 0–15 m.

12. *Holothuria (Halodeima) edulis* Lesson, 1830

SEE: Rowe & Doty, 1977 : 231.

COLLECTION SITES: Muscat, Oman; SW Kalpitiya, Sri Lanka; Klah, Pula Wé, Sumatra (6 specimens). Individuals were also observed but not collected at other localities.

HABITAT & DEPTH: Sublittoral sand, often around coral or seagrass; 2–8 m.

13. *Holothuria (Lessonothuria) insignis* Ludwig, 1875

SEE: Ludwig, 1875 : 30.

COLLECTION SITE: c. 3 km offshore from Negombo, Sri Lanka (1 specimen), representing new record for Sri Lanka area.

HABITAT & DEPTH: Coral reef; 5 m.

14. *Holothuria (Lessonothuria) pardalis* Selenka, 1867

SEE: Rowe & Doty, 1977 : 233.

COLLECTION SITE: SE Klah, Pula Wé, Sumatra (1 specimen).

HABITAT & DEPTH: Sublittoral sand/rubble, sublittoral rock; 2 m.

15. *Holothuria (Mertensiothuria) leucospilota* (Brandt, 1835)

SEE: Rowe & Doty, 1977 : 233; Bonham & Held, 1963 : 305 (ecology).

COLLECTION SITES: Muscat, Oman; Galle, Sri Lanka (5 specimens).

Many other individuals were also observed (> 500 mm in length) but were not collected.

HABITAT & DEPTH: Mixed coral/rock and sand beach, sublittoral rock, coral reef; 0–5 m.

16. *Holothuria (Microthele) axiologa* H. L. Clark, 1921

SEE: Rowe & Doty, 1977 : 231.

COLLECTION SITE: SW Klah, Pula Wé, Sumatra (1 specimen), representing new record for East Indies.

HABITAT & DEPTH: Coral reef sand; 4–5 m.

17. *Holothuria (Microthele) nobilis* (Selenka, 1867) Fig. 2

SEE: Rowe & Doty, 1977 : 231.

COLLECTION SITES: Chetlat Is., Laccadives: Ug Tapa Gadja, Pula Wé, Sumatra (2 specimens).

HABITAT & DEPTH: Coral reef sand, sublittoral sand; 0.5 & 10 m.

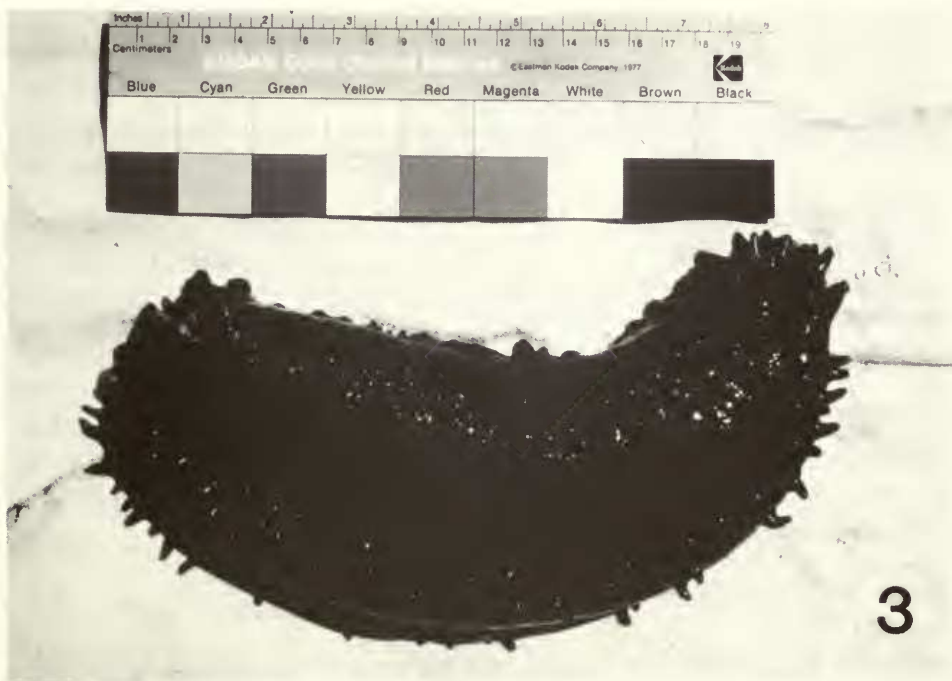


Fig. 2. *Holothuria (Microthele) nobilis* (Selenka) from Chetlat, Laccadives, (Scale = 2 cm).

Fig. 3. *Stichopus chloronotus* Brandt from Chetlat, Laccadives. (Scale indicated in photograph).

18. *Holothuria (Platyperona) difficilis* Semper, 1868

SEE: Rowe & Doty, 1977: 232; Bakus, 1968: 23 (ecology).

COLLECTION SITE: SW Kalpitiya, Sri Lanka (2 specimens).

HABITAT & DEPTH: Coral reef sand; 2 m.

19. *Holothuria (Selenkothuria) parva* Krauss in Lampert, 1885

SEE: Cherbonnier, 1952 : 503.

COLLECTION SITE: Nr Muscat, Oman (1 specimen).

HABITAT & DEPTH: Sand beach; 0 m.

20. *Holothuria (Semperothuria) flavomaculata* Semper, 1868

SEE Semper, 1868 : 87; Clark & Rowe, 1971 : pl. 27, fig. 15.

COLLECTION SITE: SW Kalpitiya, Sri Lanka (1 specimen), representing new record for Sri Lanka area.

HABITAT & DEPTH: Coral reef sand; 4 m.

21. *Holothuria (Semperothuria) imitans* Ludwig, 1875

SEE: Ludwig, 1875 : 33; Clark & Rowe, 1971 : pl. 27, fig 16.

COLLECTION SITE: Galle, Sri Lanka (1 specimen).

HABITAT & DEPTH: Coral reef; 4–5 m.

22. *Holothuria (Thymiosycia) hilla* Lesson, 1830

SEE: Rowe & Doty, 1977 : 232.

COLLECTION SITES: Muscat, Oman; Chetlat Is., Laccadives (3 specimens).

HABITAT & DEPTH: Coral reef sand, coral rubble; 0.5 & 2 m.

STICHOPODIDAE

23. *Stichopus chloronotus* Brandt, 1835 Fig. 3

SEE: Rowe & Doty, 1977 : 227.

COLLECTION SITES: Chetlat Is., Laccadives; SW Klah, N Rubiah Is., Pula Wé, Sumatra (4 specimens). Other individuals were also observed but not collected.

HABITAT & DEPTH: Coral reef sand, sublittoral rock/coral; 0.5–9 m.

24. *Stichopus horrens* Selenka, 1867

SEE: Rowe & Doty, 1977 : 227.

COLLECTION SITE: Klah, Pula Wé, Sumatra (1 specimen, partly decomposed).

HABITAT & DEPTH: Coral reef sand; 12–15 m.

25. *Stichopus variegatus* Semper, 1868

SEE: Sloan *et al.*, 1979 : 124.

COLLECTION SITES: Muscat, Oman; Ug Murung, Pula Wé, Sumatra (2 specimens). Individuals were also observed but not collected.

HABITAT & DEPTH: Coral reef, sublittoral rock; 3 m.

26. *Thelenota ananas* (Jaeger, 1833)

SEE: Rowe & Doty, 1977: 227.

COLLECTION SITES: N & SW Klah and SW Ug Bau, Pula Wé, Sumatra (3 specimens).

HABITAT & DEPTH: Coral reef sand, sublittoral rock; 4–22 m.

CUCUMARIIDAE

27. *Leptopentacta imbricata* (Semper, 1868)

SEE: Panning, 1966 : 57; Clark & Rowe, 1971 : pl. 29, fig. 5 (as *L. javanicus*).

COLLECTION SITE: Beypore, India (5 specimens), representing new record for W India & Pakistan area.

HABITAT & DEPTH: Sublittoral mud; 9 m.

28. *Plesiocolochirus* sp.

Spicule configuration insufficiently distinctive for specific determination.

COLLECTION SITE: Pallugaturai, Sri Lanka (5 specimens), representing new record of genus in Sri Lanka area. Many other individuals were also observed but not collected.

HABITAT & DEPTH: Intertidal mud and sand; 0 m.

SYNAPTIDAE

29. *Synapta maculata* (Chamisso & Eysenhardt, 1821)

SEE: Rowe & Doty, 1977 : 234.

COLLECTION SITES: Chetlat Is., Laccadives: SW Rubiah Is., Pula Wé, Sumatra (2 specimens, one of which was c. 2 m long when alive).

HABITAT & DEPTH: Coral reef sand; c. 2–10 m.

30. *Synaptula alba* Heding, 1928

SEE: Heding, 1928 : 171.

COLLECTION SITES: Ug Murung and S Ug Bau, Pula Wé, Sumatra (2 specimens, > 1 m in length when alive).

HABITAT & DEPTH: Sponge, sublittoral rock/rubble; 18–20 m.

31. *Synaptula reticulata* (Semper, 1868)

SEE: Semper, 1968 : 13 (as *Synapta reticulata*)

COLLECTION SITE: Ug Bau, Pula Wé, Sumatra (20 specimens).

HABITAT & DEPTH: Sponge; 40 m.

Synaptula sp.

Spicule configuration insufficiently distinctive for specific determination.

COLLECTION SITES: S & SE Klah, Pula Wé, Sumatra (2 specimens).

HABITAT & DEPTH: Coral reef, sublittoral rock/rubble; 2–8 m & 10 m.

CHIRIDOTIDAE

32. *Chiridota stuhlmanni* Lampert, 1896

SEE: Heding, 1931 : 676.

COLLECTION SITE: S Klah, Pula Wé, Sumatra (2 specimens), representing new record for East Indies.

HABITAT & DEPTH: Coral reef; 2–8 m.

Discussion

At least 32 species of holothurians are here reported as a result of collections made during the *Sindbad Voyage*. These are all shallow Indo-West Pacific species, often of widespread distribution and probably originating largely from the Indonesian area. Following the zoogeographic divisions of the Indo-Pacific adopted by Clark & Rowe (1971), one genus and 5 species are newly recorded: W India & Pakistan (1 species); Sri Lanka area (1 genus & 2 species) and the East Indies (2 species). Their previously known limits of range are indicated below.

Holothuria (*Lessonothuria*) *insignis*—Mascarene Is. and E Africa & Madagascar; Bay of Bengal eastwards to S Pacific Is.

Holothuria (Microthele) axiologa—N Australia and S Pacific Is.

Holothuria (Semperothuria) flavomaculata—Red Sea; E Indies, Philippine Is, and S Pacific Is.

Leptopentacta imbricata—SE Arabia, ?Maldivé area, Sri Lanka area eastwards (excluding N Australia) to China & S Japan.

Plesiocolochirus—Three Indo-Pacific species are recognised, previously recorded only in the E Indies and N Australia.

Chiridota stuhlmanni—Is. of W Indian Ocean, E Africa & Madagascar and Red Sea; Sri Lanka area and S Pacific Is.

In most cases, the new holothurian records extend the range westwards from the eastern side of their known distribution. With the exception of *H. (M.) axiologa* and *Plesiocolochirus* sp., it can be seen that these holothurians also occur on the western side of the Indian Ocean.

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References

- Aziz, A. 1981. The echinoderms collected from the coral reefs of Pari Islands, Seribu Islands (in Indonesian). *Oceanologi di Indonesia* **14**: 41–50.
- Bakus, G. J. 1968. Defensive mechanisms and ecology of some tropical holothurians. *Marine Biology Berlin* **2**: 23–32.
- Bell, F. J. 1884. Echinodermata. In: Coppinger, R. W. *Report on the Zoological collections made in the Indo-Pacific Ocean during the voyage of H.M.S. 'Alert', 1881–82*. Trustees of the British Museum, London. pp. 117–177 & 509–512.
- 1885. On the echinoderm fauna of the island of Ceylon. *Report of the British Association for the Advancement of Science. London 1885*: 1065.
- 1886. On the holothurians of the Mergui Archipelago collected for the Trustees of the Indian Museum, Calcutta, by Dr. John Anderson. *Journal of the Linnean Society of London (Zoology)* **20**: 25–28.
- 1887. Report on a collection of Echinodermata from the Andaman Islands. *Proceedings of the Zoological Society of London 1887*: 531–534.
- 1888a. Report on a collection of echinoderms made at Tuticorin, Madras, by Mr E. Thurston. *Proceedings of the Zoological Society of London 118*: 383–389.
- 1888b. On the Echinodermata of the Sea of Bengal. *Report of the British Association for the Advancement of Science 1888*: 718.
- 1889. Additions to the echinoderm fauna of the Bay of Bengal. *Proceedings of the Zoological Society of London 1889*: 6–7.
- Bonham, K. & Held, E. E. 1963. Ecological observations on the sea cucumbers *Holothuria atra* and *H. leucospilota* at Rongelap Atoll, Marshall Islands. *Pacific Science. Honolulu* **17**: 305–314.
- Cherbonnier, G. 1952. Contribution à la connaissance des Holothuries de l'Afrique du Sud. *Transactions of the Royal Society of South Africa. Cape Town* **33**: 469–509.
- 1955. Résultats scientifiques des campagnes de la 'Calypso'. Les holothuries de la Mer Rouge. *Annales de l'Institut Océanographique. Monaco & Paris* **30**: 129–183.
- Clark, A. M. & Rowe, F. W. E. 1971. *Monograph of the Shallow-Water Indo-West Pacific Echinoderms*. 1–238 pp., London.
- Daniel, A. & Halder, B. P. 1974. Holothuroidea of the Indian Ocean with remarks on their distribution. *Journal of the Marine Biological Association of India* **16**: 412–436.
- Domantay, J. S. 1957. The zoogeographical distribution of the Indo-Pacific Holothuroidea. *Proceedings of the 8th Pacific Science Congress* **3**: 417–455.
- Heding, S. G. 1928. Synaptidae. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening i Kjøbenhavn* **85**: 105–323.

- 1931. Über die Synaptiden des Zoologischen Museums zu Hamburg. *Zoologischer Jahrbücher. Jena* (Systematik) **61**: 637–696.
- 1940. Die Holothurien der deutschen Tiefsee-Expedition. 2. Aspidochirote und Elaspode Formen. *Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf den dampfer 'Valdivia'*. **24**: 317–375.
- Hornell, J.** 1917. The Indian beche-de-mer industry, its history and recent revival. *Madras Fisheries Bulletin* **11**: 119–150.
- James, D. B.** 1976. The beche-de-mer resources of India. In: *The Proceedings of the Symposium on Living Resources of the Seas around India*. pp. 706–711.
- Jones, S.** (Ed.) 1971. *Bibliography of the Indian Ocean*. Marine Biological Association of India. 1–573 pp.
- Koehler, R. & Vaney, C.** 1908. Littoral Holothurioidea. *Echinoderma of the Indian Museum*. Calcutta. pp. 1–54.
- Lincoln, R. J. & Sheals, J. G.** 1979. *Invertebrate Animals: Collection & Preservation*. British Museum (Natural History) & Cambridge University Press. pp. 1–150.
- Ludwig, H.** 1875. Beiträge zur Kenntniss der Holothurien. *Arbeiten aus dem Zoologisch-Zootomischen Institut in Würzburg* **2**: 77–120.
- 1882. List of the Holothurians in the collection of the Leyden Museum. *Notes from the Leyden Museum. Leiden* **4**: 127–137.
- 1891. Bemerkungen über einige ceylonisches Echinodermen. *Verhandlungen des Naturhistorischen Vereins der Preussischen Rheinlande und Westfalens. Bonn* **47**: 98–105.
- Panning, A.** 1944. Die Trepangfischerei. *Mitteilungen aus dem Zoologischen Staatsinstitut und Zoologischen Museum in Hamburg* **49**: 1–76.
- 1966. Bemerkungen über die Holothurien-Familie Cucumariidae (Ordnung Dendrochirota). 5. Die Gattungen *Heterothyone* Panning, 1949 und *Leptopentacta* H. L. Clark, 1938. *Mitteilungen aus dem Zoologischen Staatsinstitut und Zoologischen Museum in Hamburg* **63**: 51–59.
- Pearson, J.** 1913, 1914. Notes on the Holothurioidea of the Indian Ocean. *Spolia Zeylanica* **9**: 49–101: 173–190.
- Roberts, D.** 1979. Deposit feeding mechanisms and resource partitioning in tropical holothurians. *Journal of Experimental Marine Biology and Ecology. Amsterdam* **37**: 43–56.
- & **Darsono, P.** 1984. Zonation of reef flat echinoderm at Pari Island, Seribu Islands, Indonesia. *Oceanologi di Indonesia* No. 17: 33–41.
- Rowe, F. W. E.** 1969. A review of the family Holothuriidae (Holothurioidea Aspidochirodita). *Bulletin of the British Museum (Natural History)*. London (Zoology) **18**: 119–170.
- Rowe, F. W. E. & Doty, J. E.** 1977. The shallow-water holothurians of Guam. *Micronesica* **13**: 217–250.
- Semper, C.** 1868. Holothurien. *Reisen in Archipel der Philippinen*. 2. Wissenschaftliche Resultate. 1–288 pp. Wiesbaden.
- Sloan, N. A., Clark, A. M. & Taylor J. D.** 1979. The echinoderms of Aldabra and their habitats. *Bulletin of the British Museum (Natural History)*. London (Zoology) **37**: 81–128.
- Théel, H.** 1886. Holothurioidea. Part 2. *Report of the Scientific Results of the Voyage of H.M.S. Challenger* 1873–76. London **39**: 1–290.